A re-examination of the anterior dental loading hypothesis. M. GLANTZ, M. MURPHY, M. CHANG, University of Pennsylvania, Philadelphia, PA 19104 and S. ATHREYA, Washington University, St. Louis MO 63130.

The craniofacial morphology of neandertals has been described as reflecting functional demands placed on the anterior dentition. The pattern and extent of anterior dental wear relative to molar wear has been used to generate as well as support this hypothesis. Because reaction forces acting on the mandibular condyles are maximal during incisal biting, an examination of ramal and condylar morphology with respect to anterior dental wear is necessary in relating the functional and/or structural relationships between these two regions.

In the present study, a geographically diverse sample of recent humans was examined to assess the morphological patterning of the masticatory apparatus under a wide spectrum of functional demands. The sample includes approximately thirty individuals from each of 6 geographic regions (n=180), including Alaska, Greenland, the Near East, northern Europe, Africa, and southeastern United States. It also includes neandertal and middle Pleistocene hominids. Measures reflecting biomechanical properties of the mandible and maxilla were recorded in addition to metric and non-metric features of the maxilla, mandible and dental arcade. Dental dimensions and the pattern and extent of dental wear and bite pattern were also scored. Multivariate analyses were used to determine significant relationships among these features and ANOVAs were performed to indicate differences in these relationships between sub-samples.

The results of this study indicate that relative anterior dental wear is the product of individual bite dynamics. Bite, in part, is dependent on mandibular morphology and the corresponding organization of the muscles of mastication. In this sense, structural interdependencies between the mandible, dentition, and face, rather than population specific functional demands, better explain the pattern of dental wear used to support the anterior dental loading hypothesis. Moreover, neandertals do not differ significantly from other populations in the sets of characters often assumed to be related to the functional demands placed on their anterior dentitions when patterns of intra-populational variation are considered.

Cercopithecus mona All-male Groups: A New Phenomenon in the *Cercopithecus* genus? GLENN, M.E., and BENSEN, K.J. Windward Islands Research and Education Foundation, 11 East Main Street, Suite 154, Bayshore, NY 11706, USA.

Approximately 300 years ago, during the height of the African slave trade to the Americas, a small number of mona monkeys (*Cercopithecus mona*) from mainland Africa were introduced to the Caribbean island of Grenada where they have since become naturalized. From September 1992 through April 1995, we examined the group size and composition of this previously unstudied guenon population. Two types of social groups were found: bisexual groups containing 5 to 32 individuals ($\bar{x}$ = 18.0, SD = 7.0) and all-male groups consisting of 2 to 4 individuals ($\bar{x}$ = 2.3, SD = 0.5). Bisexual groups contained one adult male, 1 to 6 adult females, subadult females, and juveniles and infants of both sexes. All-male groups consisted of any combination of juveniles, subadults and/or adults. The composition found for mona bisexual groups on Grenada was similar to that described for most African forest guenons, including African *C. mona*. In contrast, all-male groups, which were a common occurrence on Grenada, have never been reported for African *C. mona*, and have been reported only in two other forest *Cercopithecus* species. *Cercopithecus*, the genus of guenons, is the largest of the African primate genera, and yet more than half of the species belonging to this group have never been the focus of a long-term field study. Additional research of these unstudied guenon populations is needed in order to determine if the presence of all-male groups is indeed a rare phenomenon within the *Cercopithecus* genus, and if so, why.

Lemur biogeography: Lessons from Madagascar's subfossil past. L.R. GODFREY, Department of Anthropology, University of Massachusetts, Amherst, MA, 01003-4805, W.L. JUNGERS, Department of Anatomical Sciences, SUNY at Stony Brook, New York, 11794-8081, E.L. SIMONS, P.S. CHATRATH, Duke University Primate Center, 3705 Erwin Road, Durham, NC 27705-5000, and B. RAKOTOSAMIMANANA, Service de Paléontologie, BP 906, Université d'Antananarivo, Antananarivo 101, Madagascar.

Late Pleistocene and Holocene cave, marsh, and stream deposits on the island of Madagascar have yielded thousands of "subfossil" specimens that document recent megafaunal extinctions. Excavations conducted during the past 15 years of archaeological and paleontological sites in northern, northwestern and southwestern Madagascar have unearthed, in addition to new specimens of extinct lemurs and other megafauna, an abundance of bones of still-extant lemur species. These specimens, as well as specimens of extant lemurs from subfossil sites excavated in the early 1900's, prove that living lemur species once had much broader geographic ranges than they enjoy today, and they help to explain the currently disjunct distributions of some.

This paper examines the pattern of distribution of extant and extinct primate species at subfossil sites. It uses Jaccard similarity coefficients to compare extant-primate community compositions at subfossil sites to those at 25 modern forests. Specimens of some eastern rain forest taxa, such as *Varecia variegata*, *Indri indri*, and *Hapalemur simus*, have been identified at subfossil sites in the dry west. A tibia of the extinct *Daubentonia robusta*, previously known only from the arid southwest, was found at Ampasambazimba, a site west of Antananarivo. Our

data demonstrate that the boundaries of the geographic distributions of typically wet-loving and typically-dry loving species were quite fluid; fingers of "eastern" forest once spread across the island, perhaps all the way to the west coast. The Central Highlands functioned as a crossroads for the dispersal of species in both east-west and north-south directions.

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Archaeology and the human colonization of Siberia, Alaska, and New World: do stones, bones, and genes tell the same story? T. GOEBEL, University of Nevada, Las Vegas, and G. R. SCOTT, Arizona State University.

Recent genetic and linguistic studies imply an "earlier than Clovis" migration of humans from Asia to the Americas during the late Pleistocene, but we agree with Meltzer (1995) that only archaeology can provide the firm evidence for a pre-12,000-BP human population in the New World. However, with the Monte Verde site in southern Chile possibly breaking the "Clovis barrier," archaeologists have reached a point were they too must reconsider the timing and the process of human colonization of the Americas. In this paper, we propose such a model, one that is unique in that it brings together the genetic, dental, and linguistic data with archaeological data from a normally ignored area of the world—Siberia and Beringia, to provide a new perspective on the peopling of the Americas problem. Through an examination of the archaeological records of Siberia and Alaska, we argue that 1) human adaptations permitting the sustained settlement of the Siberian subarctic did not develop until about 25,000 years ago; 2) Beringia was not colonized until after the last glacial maximum, less than 15,000 years ago, and 3) if humans passed from Beringia to the Americas south of the Canadian ice sheets earlier than 12,000 years ago (as Monte Verde suggests), then a coastal route would have been required in lieu of an interior one. We conclude by attempting to reconcile the northern archaeological record with current genetic, dental, and linguistic data, proposing a new model explaining the colonization of northern Siberia, Beringia, and the Americas.

Native American interactions in protohistoric Virginia: a bioarchaeological perspective from the interior. D.L. GOLD, University of Michigan Museum of Anthropology, Ann Arbor, MI 48109-1079.

The English settlers at Jamestown did not travel to Virginia's interior. Indirectly, however, the European presence played an important role in shaping the relationships between the coastal (Powhatan) and interior (Monacan) native peoples of Virginia in the late 16th and 17th centuries.

This paper examines the historical context of these interactions from a bioarchaeological perspective. Macroscopic osteological indicators of demography, subsistence and health patterns were examined at two interior Virginia burial mound sites dating to the Late Woodland period: Lewis Creek Mound (44AU20), ca. A.D. 985-1225, located west of the Blue Ridge Mountains; and Rapidan Mound (44OR1), ca. A.D. 1290-1440 or later, located in the eastern piedmont. The skeletal remains of more than 150 individuals from these two sites were studied.

Analysis included examination of dental caries and wear; periodontal disease; systemic infection; enamel hypoplasia and other skeletal indicators of growth interruption; degenerative disease processes; and accidental and deliberately-inflicted violent trauma. Similarities and differences in mortuary patterning at the two sites are also of significant interest and are considered in this analysis.

Results indicate that a subsistence pattern of significant maize consumption combined with continued reliance on wild plant and animal resources was established early in the Late Woodland period and remained relatively stable over hundreds of years. During this time, population health improved significantly and the prevalence of hostile trauma appears to have increased.

Based on archaeological and ethnohistoric data, Hantman (1993) has suggested that the coastal Powhatan peoples used the English presence in the late 16th and early 17th centuries to enhance their position in the region. The bioarchaeological data presented here support this view, but also suggest potentially greater time depth and variability to the complex interactions among coastal and interior peoples in late prehistoric and protohistoric Virginia.

Preferred collagen fiber orientation in the human mid-shaft femur. H.M. GOLDMAN and T.G. BROMAGE, Hard Tissue Research Unit, Dept. of Anthropology, Hunter College of C.U.N.Y., New York, 10021; R. BRUNS, J.G. CLEMENT, C.D.L. THOMAS and S. FEIK, Dept. of Oral Anatomy, School of Dental Science, University of Melbourne, Victoria 3000, Australia.

The preferred orientation of collagen fibers within bone, as studied by circularly polarized light microscopy (CPL), has been shown to be a particularly good indicator of bone strength (Martin & Ischida, 1989). Transversely oriented collagen fibers, appearing bright in CPL, are best able to withstand high compressive strain. Longitudinally oriented collagen, appearing dark in CPL, are better able to withstand tensile strain. The patterning of collagen fiber orientation within human bone has rarely been investigated. Portigliatti Barbos *et al.* (1983, 1984) reported a distinct pattern of collagen fiber distribution in the mid-shaft femur cortex in two young male individuals. The universality of this 'human pattern' has never been tested, nor has any investigation into variability between the sexes or with age been completed.

As part of a study of age and sex variability in modern human bone microstructure, 100 μm thick sections were prepared from a sub-sample (n=28) of mid-shaft femur blocks collected from the Victorian Institute of Forensic Medicine, Melbourne, Australia. The material represented equal numbers of males and females representing two age groups (20-40 years old and over 65 years old). Using an adaptation of the methodology of Boyde & Riggs (1990), the sections were imaged at very low magnification with

CPL, and pseudo-color images were produced, providing a visual map of relative brightness over the entire bone cortex.

Collagen fibers were non-randomly distributed in most individuals, though patterns were quite variable and only a few individuals showed a similar pattern to that reported by Portigliatti-Barbos *et al.* Some older females lacked any discernable pattern completely. Older individuals tended to have a greater proportion of transverse lamellae than younger individuals. In those individuals with a pattern, the anterior cortex and linea aspera consistently showed a high proportion of longitudinally oriented lamellae. The medial cortex tended to have a higher proportion of transverse fibers, but not in all individuals. The lateral cortex appeared to be most variable.

This study indicates that collagen fibers show preferential patterning in the human mid-shaft femur, though a high variability exists in a sample representing both sexes and a wide age range.

This work was supported by predoctoral grants from the National Science Foundation and the L.S.B. Leakey Foundation, and an NSF equipment grant to the Analytical Microscopy and Imaging Center in Anthropology, Hunter College.

Gorilla behavioral ecology: effects of altitudinal changes on highland/lowland populations. M.L. GOLDSMITH, Dept. of Environmental and Population Health, Tufts University School of Veterinary Medicine, Grafton, MA, J.B. NKURUNUNGI, Dept. of Zoology, Makerere University, Kampala, Uganda, and C.B. STANFORD, Dept. of Anthropology, USC, Los Angeles, CA.

Morphological and genetic data are most often used to distinguish among species (and subspecies). Recently, however, some researchers have begun to include information on differences in behavioral ecology, such as diet, degree of arboreality, daily travel length, etc.

Findings from two gorilla populations (western lowland gorillas in Bai Hoköu, Central African Republic and mountain gorillas in Bwindi-Impenetrable National Park, Uganda) will show that ecological variables influence behavior in similar ways. This supports the notion that differences in behavior should be used with caution when defining species or subspecies.

Bai Hoköu lowland gorillas and Bwindi mountain gorillas incorporate more fruit into their diet than do Virunga mountain gorillas. At Bai Hoköu, when gorillas were feeding on fruits, groups traveled farther each day and were less cohesive than when gorillas concentrated on herbaceous and fibrous vegetation. Preliminary results from Bwindi suggest that they too traveled longer daily distances and were less cohesive when feeding on fruits. In Bai Hoköu and Bwindi, multimale groups are more common than in the Virungas, and may provide a means to reducing within-group feeding competition.

Gorilla behavior, in these studies, appear to be altitude-specific and occur along a continuum. At low elevations (Bai Hoköu), gorillas are the most frugivorous, have the longest day ranges, and the least cohesive groups, while at high elevations (Virungas), gorillas are the least frugivorous, travel the shortest distances, and have the most cohesive groups. The behavioral ecology of gorillas at more mid-elevations (Bwindi) fall in-between these two extremes. The fact that behavioral ecology is so flexible from population to population suggests it may be a poor indicator of species or subspecies differences.

Goldsmith's work in Bai Hoköu was funded by Fulbright IIE, Wildlife Conservation Society, Wenner-Gren, and the Leakey Foundation. Work in Bwindi was funded by Dartmouth Claire Goodman grants to Goldsmith and collaborative grants with Stanford from Primate Conservation Inc. and National Geographic Society.

Shifting social dynamics in a group of mantled howler monkeys *(A. palliata)* on the Island of Ometepe, Nicaragua. S. Z. GOLDSMITH, University of Wisconsin, Milwaukee, L. WINKLER, University of Pittsburgh, Titusville.

The complexity and flexibility of New World primate social dynamics have become increasingly obvious. Several styles of social organization have now been described for *Alouatta palliata* including a fission-fusion pattern (Kinzey and Cunningham, 1994). This study examines shifting social dynamics which occurred in an *A. palliata* group demonstrating a fission-fusion pattern at the Ometepe Biological Field Station, Nicaragua.

The study group consisted of 13 adults (5 males, 8 females) and 8 immature animals. All adults could be identified, most by collars placed during a capture/release project (Winkler et al., in prep.). A total of 672 focal animal observations (2 minute intervals) in addition to 33.7 hours of focal animal sampling (data on travel order, displacement/avoidance, proximity, intragroup movements and activity) was collected in July and August of 1998. For the first 16 days of observation, the group functioned as a cohesive unit foraging and traveling together but then split into two subgroups for a period lasting 7 days. One subgroup was unimale (4 females, 5 immature). The other subgroup was multimale (4 males, 4 females, 3 immature). Hierarchy was assessed via age, displacement/avoidance behavior, and travel order (Glander, 1980; Goldsmith, in prep.; Jones, 1980).

Shifts in hierarchy appeared to occur as a result of the fission with lower ranking animals assuming higher positions in the subgroups. Several animals were noted to form smaller subgroups within the 2 larger subgroups including a multiparous female with juvenile and a subadult female which demonstrated alloparenting behavior. Two older multiparous females demonstrated substantial travel independence of subgroup males with one adult female/immature pair shifting from the single male to the multiple male subgroup after three days. In concordance with Chapman (1988), we attribute the fission-fusion pattern to food patch distribution and food availability but also believe that forest fragmentation played a role. We discuss these factors and the potential implications of fission-fusion patterns for howling monkey social organization. We acknowledge the support provided by the Ometepe Biological Field Station.

Systematic use of video as a data collection and training tool in free-ranging, semi-free ranging, and captive studies of non-human primates. GOLDSTEIN, G.R., Chimpanzee and Human Communication Institute, Central Washington University, FUENTES A., Dept. of Anthropology, Central Washington University, and SNIVELY, D., Dept. of Communication, Central Washington University, Ellensburg, WA 98926

The systematic use of video is a valuable tool for research and teaching in Primatology. However, to date little emphasis has been placed in videographic technique and choice of format in video data collection.

Comparisons of video use in a range of field and captive conditions illustrate similar benefits and limitations. Here we present an overview of three cases in which video was used as an integral component in data collection.

Video was used in the following studies: free-ranging chimpanzees in Uganda, Africa, semi-free ranging macaques in Bali, Indonesia, and captive chimpanzees at the Chimpanzee and Human Communication Institute at Central Washington University. Video use benefits include: intensive re-examination of specific behavior, video capture of rare behavior, non-invasive nocturnal and diurnal data collection, and the construction of observer training and individual/behavior identification tapes. Video use limitations include: battery power and lifespan, weather and other field conditions, and technological limitations in camera type and video format. This comparison also highlights the critical importance of videographic technique and training for effective video data collection.

Evolutionary Genetics of Chimpanzees (*Pan troglodytes*) in Nigeria and Cameroon. M.K. GONDER, J.F. OATES, Hunter College and Graduate School of the City University of New York, 695 Park Avenue, New York, NY 10021 and T.R. DISOTELL, New York University, 25 Waverly Place, New York, NY 10003

The Niger River and the Dahomey Gap are often considered to be the most important faunal dispersal barriers in West Africa, influencing post-glacial forest expansion and the recent evolution of many species. As such, three geographically disjunct subspecies of chimpanzee (*Pan troglodytes*) are generally recognized: West African *P.t. verus*, Central African *P. t. troglodytes* and East African *P. t. schweinfurthii*, with the Niger River in Nigeria separating the West and Central African subspecies. The classification of these subspecies and their recent evolution has come under considerable debate in the past few years as more genetic evidence from wild chimpanzee populations has become available. Previously, we published hypervariable region I mtDNA sequence data from a limited sample of chimpanzees from Nigeria. Our data suggested that a distinct chimpanzee form may be present in Nigeria and adjacent parts of Cameroon and that the geographic barriers thought to delimit chimpanzee populations may be different than proposed.

Here we present a much larger sample of mtDNA sequences derived from hairs found in the sleeping nests of chimpanzees from 16 localities across Nigeria and Cameroon. Hair samples from 213 nests were collected on different sides of potential biogeographic barriers throughout the region, including both sides of the Niger and Sanaga Rivers. Preliminary analyses of these mtDNA sequences provide further support that a phylogenetically unique group of chimpanzees ranges in Nigeria and adjacent parts of Cameroon, and that a phylogeographic break between West and Central African chimpanzees occurs in central Cameroon and possibly at the Dahomey Gap, but not at the Niger River. These results suggest the need for a reclassification of chimpanzees.

This research was funded by the L.S.B. Leakey Foundation, Primate Conservation, Inc., the National Science Foundation and the Wenner-Gren Foundation.

Allometric scaling of articular surface areas in *Papio anubis*. A.D. GORDON, Department of Anthropology, University of Texas, Austin, TX 78712-1086.

The question of whether joint size is constrained mostly by the types of movements which occur at that joint or the mechanical loadings to which it is subjected is difficult to address. Past studies attempting to answer this question have focused mostly on interspecific scaling patterns of articular surface area with body mass. The present study uses a different approach, that of analyzing intraspecific scaling patterns of femoral and humeral head surface areas in a sample of male and female wild-caught *Papio anubis* individuals.

Measurements of the femoral head surface area (FHSA) and humeral head surface area (HHSA) for each individual were made by digitizing each sample with a 3-D laser scanner. Each digitized image was then used to calculate the area of the articular surface.

Analysis of the relationships between FHSA, HHSA, and body mass indicates that sexual dimorphism exists in the scaling patterns of articular surfaces in the sample group. Behavioral information from the literature suggests that differences in locomotor behavior between male and female adult wild baboons may favor reduced joint mobility as an adaptation for increased cursoriality in males. These results indicate that joint mobility is the major constraint on joint size in *Papio anubis*, although further studies of sex differences in locomotor behavior and mechanical loadings of joints should be conducted to further clarify the issue. In addition, more intraspecific studies need to be conducted on a variety of primate species to determine if joint mobility is the major constraint on joint size for all primates, or if the relative importance of the two constraints on joint size varies among primate taxa.

Supported by grants from the National Science Foundation and the University of Texas at Austin.

The use of prior probabilities in ageing perinatal skeletal remains: implications for the evidence of infanticide in Roman Britain. R. L. GOWLAND and A. T. CHAMBERLAIN. Department of Archaeology and Prehistory, University of Sheffield, S1 4ET, U.K.

The skeletal remains of substantial numbers of perinatal infants have been excavated from a variety of archaeological contexts dating to the Romano-British

period (AD 50 to AD 450). Recently Mays (1993) aged a sample of these perinatal skeletons from long bone length using the method derived by Scheuer *et al.* (1980). The resulting distribution exhibited a strong peak at approximately full term and this has been interpreted as evidence for infanticide.

Several authors have demonstrated that the age structure of a reference sample exerts a profound influence on the ages estimated from a skeletal population. This study investigates the extent to which the neonatal peak apparent in the Romano-British data is an artefact of the ageing method used. The long bone diaphyseal lengths of a sample of 396 perinatal infants from 19 Romano-British sites and comparable data for known age perinatal infants from several clinical studies were obtained. The probability of age given long bone length was deduced from the known age data using both uniform and fixed model prior probabilities, the latter being obtained from modern perinatal mortality records. These probability distributions were then used to determine the gestational age of the archaeological skeletons and the results compared with those obtained using the Scheuer *et al.* (1980) method.

Significant differences in the age distributions were revealed, with the ages derived from the fixed prior probabilities falling within parameters expected for natural perinatal mortality. It is argued from this analysis that there is no osteological evidence for infanticide in Roman Britain, instead the age distribution is compatible with that expected when both stillbirths and neonatal deaths are accorded similar burial rites.

Measuring seed dispersal distance with genetic markers: preliminary results. B.W. GRAFTON, J.V. FREUDENSTEIN, and M.A. NORCONK, Anthropology and Biological Sciences, Kent State University, Kent, OH 44242.

An estimated 50-90% of neotropical plants depend on vertebrate frugivores to disperse their seeds, and many neotropical primates have been considered potentially effective dispersal agents. While much information about the numbers of plant species dispersed and the viability of primate-dispersed seeds is available, less is known about such post-dispersal consequences as variation in the distance seeds are dispersed from parent trees or the seed shadows produced by these primates. Molecular techniques may allow for more precise measurement of these variables and thus provide a better estimate of the contribution of a particular dispersal agent to the reproductive success of a particular plant. Specifically, this preliminary investigation examined the use of genetic markers to map the primate-generated seed shadows of individual trees. The tropical tree *Brosimum alicastrum* (Moraceae) was chosen as a test species because all three primate species (*Alouatta seniculus*, *Cebus olivaceous*, *Chiropotes satanas*) at the Danto Manchado study site in Guri Lake, Bolivar State, Venezuela have some effect on initial seed fate. Leaf tissue and 10 fruits from each of 10 adult trees located throughout the study site were collected June 1997 and preserved (leaf tissue in silica gel, seeds stripped of their edible pericarp and air-dried). DNA was extracted from both leaf tissue and maternally-derived seed coats using a standard CTAB protocol, and the ISSR (Intersimple Sequence Repeats) technique was applied using eight primers. The PCR-generated banding profiles were examined for identity between parent and offspring. Although all primers were not equally effective, various primer combinations were able to generate individual-specific banding profiles which segregated into clusters of adults and their offspring in the majority of cases. These preliminary results indicate that this approach is a viable one for the study of primate seed dispersal.

Where were the women? A.L. GRAUER, Loyola University Chicago, Department of Sociology and Anthropology, Chicago, IL 60626.

Historical records provide valuable insights into the past. They tend, however, to reflect the lives of men. This paper explores how synthesizing skeletal analyses with historical records can begin to alleviate this bias and provide a more inclusive picture of human life and death.

Demographic and paleopathological data from medieval British skeletal collections and historic cemeteries in the U.S. are analyzed. The results indicate that in many instances mortality rates, along with patterns of health and disease, differ between females and males. Similarly, historical records such as tax rolls, census reports, wills, and personal accounts, indicate that economic opportunities, migration, and social connections also differed between the sexes. Reasons for differing morbidity and mortality patterns are posed using historical sources, and possible biological consequences of historically documented differences between females and males are offered as a means of gaining insight into the past.

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The inclination of the resultant vector of jaw muscle force. W.S. GREAVES, Dept. of Oral Biology, Univ. of Illinois at Chicago, Chicago, IL 60612.

Studies relating to the primate masticatory apparatus often reduce the inherent complexity of this system by treating the jaw as a lever and by resolving the various forces of the jaw muscles into a single force vector. The following analysis predicts that there are only two very efficient inclinations for the resultant vector of jaw muscle force in all mammals. The model assumes that: (i) the

muscle resultant vector intersects the tooth row just behind the third molar in lateral view and (ii) since bone is metabolically expensive, a minimum amount is used to construct the upper and lower jaws. The analysis first finds equal distances between the jaw joint and the head and tail of any resultant vector. The moment of force is then calculated for a sample of potential vectors using the length of each vector and its corresponding moment arm. This moment is plotted against the angle the vector makes with a line J-M that extends from the jaw joint to the third molar. When temporalis is large (more typical in primates), the vector is inclined posteriorly and has the largest moment when it meets J-M at 45 degrees. (A dominant masseter/pterygoid complex produces an anteriorly inclined vector that forms an angle of 90 degrees with J-M when the moment is largest.) These results agree with an earlier independent theoretical analysis as well as with estimates of actual jaw muscle vectors based on dissections of jaw muscles.

Serpens Endocrania Symmetrica (SES): A new term and possible sign of cranial tuberculosis. C.M. GREENWALD, B. LATIMER, L.M. JELLEMA, Cleveland Museum of Natural History, Cleveland, Ohio 44106, U.S.A; I. HERSHKOVITZ, Anatomy/Anthropology, Sackler Faculty of Medicine, Tel Aviv University, 69978, Israel; O. DUTOUR, Universite de la Mediterranee, Marseille, France (13385), and B.M. ROTHSCHILD, Arthritis Center of N.E. Ohio, Youngstown, Ohio 44512, U.S.A.

Pathological changes specific to the endocranial table have been mostly ignored by anthropologists (HFI excepted). This study describes a sign which we are naming Serpens Endocrania Symmetrica (SES). It is defined as: variably sized areas of serpentine ridges on the internal aspect of the endocranial table with excavation by branching grooves. There is no associated inflammatory process nor erosive change.

1099 human skulls from the Hamann-Todd Collection (CMNH) were examined macroscopically and using 10x magnification. Changes were tabulated by: endocranial location, extent of bony involvement, symmetry, and associated venous sinus involvement.

SES was recognized in 30 of the 1099 skulls studied. SES is essentially bilateral,and symmetrical, usually exhibiting multiple foci. 25 of the SES cases were recorded as dying from tuberculosis (TBC). SES's correlation with TBC was highly significant (X^2=77.47, $p < 0.01$). The frequency of SES among all tuberculosis deaths was 4.6%. The causes of death for the other 5 cases were: myocarditis (n=2), and one each of pneumonia, gastric carcinoma, and syphilis.

Hyperostosis and porosity are not suitable terms for SES, and the process creating the maze like channels probably represents local blood vessel proliferation. It is doubtful that the high correlation between SES and TBC can be explained simply due to foci of tuberculous meningitis alone. It may be that SES is a noninflammatory response to adjacent meningeal pathology which is not pathognomonic for TBC.

Morphometric Variation of the Human Auditory Ossicles. T. M. GREINER & R. A. WALKER, Dept. of Anatomy, New York Chiropractic College, Seneca Falls, NY 13148

The auditory ossicles comprise a chain of three small bones that conduct and amplify sound vibrations from the outer ear to the choclear organ. Perhaps because of their size, or because of the difficulty associated with their recovery, these bones receive scant attention in most discussions of osteological variation. This presentation will help to fill that void.

About 125 ear bones, from both sides of the body, were collected from human cadavers used in the gross anatomy sequence at New York Chiropractic College. These cadavers were acquired through an anatomical study donation program, and represent persons that lived in, or around, the state of New York. The suite of measurements were selected to reflect lengths, breadths, and widths for each ossicle. Measurements were collected with a digital caliper and were recorded to .01 mm.

Data were subjected to several statistical analyses to uncover patterns and relationships between bones and among individuals. Because the function of these bones is dependent upon the strength of the sound-wave energy, one might expect them to show little variation among individuals. Our analysis bears this out, in that there are no statistical differences between left and right sides, or between males and females. There is some evidence that there may be differences among racial groups, but because our non-White sample size is small this may not be a material finding. Interestingly, there also seems to be few statistically significant correlations among the measured dimensions, either within or between particular ossicles. This finding may suggest that the ear bones are subject to strong developmental constraints, with a limited tolerance for variation. Deviations from the "basic morphological pattern" do not influence the shape of the associated bones. If this conclusion is correct, then the interaction of the ear ossicles demonstrates a functional inter-relationship that is unique among the kinematic chains in the human body.

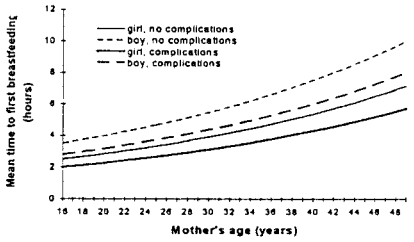
Colostrum feeding behavior and initiation of breastfeeding in rural Bangladesh. M.A. GRIMES, D.J. HOLMAN, Pennsylvania State University, University Park, PA 16802.

Breastfeeding is important both nutritionally and immunologically for the newborn infant. Colostrum, the thick yellowish secretion that precedes breast milk during nursing for up

to 4 days after delivery, is a specialized source of concentrated nutrients and antibodies. In some settings, colostrum is viewed as harmful to the child and is discarded prior to breastfeeding or breastfeeding is delayed for several days.

The purpose of this study is to examine the time to initial breastfeeding and the prevalence of colostrum feeding in Bangladesh. An 11-month prospective study was conducted in a rural sub-district of Bangladesh in 1993; 143 women gave birth during the study and answered twice-weekly questions on breastfeeding behavior. Logistic regression was used to examine effects of covariates (maternal age, parity, history of miscarriage and spontaneous abortion, sex of child, and self reported delivery complications) on the probability of a woman feeding colostrum to her newborn. Times to first breastfeeding were approximately exponentially distributed, and an exponential parametric hazards model was used to examine effects of the covariates on time to breastfeeding.

Of 130 mothers who responded to questions on colostrum feeding, 90% reported feeding their child colostrum. Four percent of mothers who said they did not feed their child colostrum still breast fed within 24 hours. None of the covariates was significantly associated with colostrum feeding behavior. Maternal age, child's sex, and delivery complications were significantly associated with the time to first breastfeeding (Figure). Younger mothers and those reporting delivery complications tended to initiate breastfeeding sooner, and girls were fed sooner than boys.



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Contexts for Contact biology. R.S. GRUMET, National Park Service, Philadelphia, PA 18938.

This paper presents a general processual framework placing contact between Native Americans and newcomers from Europe, Africa, and Asia into systematic chronological and cultural contexts first developed by Edward Spicer in 1961 and Eleanor Burke Leacock and Nancy Oestreich Lurie ten years later. Major patterns of demographic and epidemiological continuity and change are traced through five periods of contact between 1500 and 1900. Foremost among these are population losses and gains brought about by epidemic, pandemic, and chronic disease and warfare, and demographic consequences of dispossession and dislocation. A broad human ecological perspective is employed to organize and explain adaptive and maladaptive responses to the problems and opportunities associated with the biology of contact in North America.

Linear enamel hypoplasia in gibbons and other Old World Anthropoids: A graded taxonomic pattern in the expression of linear enamel hypoplasia. D. GUATELLI-STEINBERG, University of Oregon, Eugene, OR 97403.

Two previous studies (Colyer, 1936 and Vitzthum and Wikander, 1988) indicate that gibbons, like monkeys and unlike great apes, have low frequencies of enamel hypoplasia (defined to include pitting, linear defects, and irregular enamel). This study focuses specifically on linear enamel hypoplasia (LEH), a sensitive indicator of physiological stress occurring during the period of enamel formation. The purpose of this research is to determine the taxonomic distribution of LEH in Old World Anthropoids.

LEH observations (following standard procedures outlined by Goodman and Rose, 1990) were taken on feral or free-ranging samples of the following taxa: *Hylobates lar* (n=92), *Papio* (n=61), *Macaca fascicularis* (n=70) *Macaca mulatta* (n=360), *Nasalis larvatus* (n=18), *Presbytis cristata* (n=23), *Pongo pygmaeus* (n=14), *Gorilla gorilla* (n=26), and *Pan troglodytes* (n=26). An individual was considered to have LEH if defects could be matched for any antimeric pair. This convention maximizes the possibility that defects formed as a result of systemic physiological stress rather than localized trauma to the tooth germ. Individuals with three or more pairs of matched defects were considered to have multiple LEH.

The incidence of LEH in the gibbon sample is 35%, falling between the range for the Old World monkey samples (9-18%) and the range for great apes samples (39-85%). The frequency of individuals affected with multiple LEH ranges from 0-1% in the Old World monkey samples to 12-19% in the great ape samples. Gibbons again appear to be intermediate (although closer to great apes), with 10% of individuals affected with multiple LEH.

These data indicate that there is a graded taxonomic pattern in the distribution of LEH such that gibbons are intermediate between Old World monkeys and great apes in their expression of LEH. While some populations of monkeys have been shown to exhibit high frequencies of LEH (Skinner and Guatelli-Steinberg, 1997), most monkey populations exhibit lower LEH frequencies than gibbons and still lower frequencies than great apes. Potential causes of this taxonomic pattern will be discussed.

This research was supported by a grant from the National Science Foundation, SBR 9615006.

Omomyid primates from South Pass (middle Eocene, southwestern Wyoming): Diversity, anachronism, and the origin of new species. G. F. GUNNELL, Museum of Paleontology, University of Michigan, Ann Arbor, MI 48109-1079 and E. R. MILLER, Department of Anthropology, University of North Carolina, Chapel Hill, NC 27599.

Exploration of middle Eocene (earliest Bridgerian, late Gardnerbuttean) sediments along the eastern margin of the Green River Basin at South Pass (Wasatch Formation) has

yielded a relatively large sample of omomyid primates including: 1) two species each of Absarokius, Washakius, and Omomys; 2) one species each of Loveina, Trogolemur, and Uintanius, and 3) an as yet undescribed, new omomyine genus and species. Omomyid diversity at South Pass is as high or higher than any other known early Cenozoic assemblage.

South Pass is a basin-margin mammalian assemblage. Basin-margin assemblages differ in content and composition from time-equivalent assemblages derived from basin-center facies in the greater Green River Basin. Basin-margin assemblages are typified by the presence of unique, distinctive, and anachronistic taxa. Unique taxa are those absent from basin-center assemblages. Distinctive taxa are rarely represented in the basin-center, while they are relatively common from the basin margin. Anachronistic taxa are those representing precocious first appearances or delayed last appearances relative to their biostratigraphic occurrence in basin-center assemblages. Anachronistic taxa can be recognized by the co-occurrence of presumed ancestor-descendant generic couplets. For example, the co-occurrence of Loveina and Washakius at South Pass.

The South Pass vertebrate sample as a whole, but particularly the presence of anachronistic primate and other mammalian taxa, appears to fit a model of allopatric speciation whereby marginal areas may have provided habitats conducive to the production of successful evolutionary innovation. Some of the assumed conditions of allopatric speciation (e.g. geographic isolation and environmental stress) are met in these marginal habitats.

The effect of moonlight on the behavior of spectral tarsiers. S.L. GURSKY, City University of New York-Queens College, Department of Anthropology, 65-30 Kissena Blvd., Flushing, NY 11367.

The influence of moonlight on activity patterns has been well documented for many nocturnal mammals. The results of these studies have consistently shown that the majority of nocturnal mammals respond to bright moonlight by reducing their use of open space, by restricting their foraging activity, movements or the duration of the period of activity, or by switching their activity to darker periods. The goal of this paper is to explore the behavioral responses of a nocturnal primate, the spectral tarsier, Tarsius spectrum, to moonlight.

Data were collected in Tangkoko Nature Reserve, Sulawesi, Indonesia from March 1994-August 1995. Full night focal follows were conducted on eight adult females and 5 adult males. This was achieved utilizing mist nets and radio telemetry. Scan sampling methods were utilized.

Results from this study indicate that instead of reducing their activity during the full moon, spectral tarsiers substantially increased their activity levels during the full moon. Similarly, spectral tarsiers also decreased their activity during times when there was little or no moon. The frequency other forms of social behavior were exhibited (within group interactions and between group territorial disputes) also varied according to moon phase.

These observations are very intriguing because it has been hypothesized that the spectral tarsier is secondarily nocturnal based on their lack of a tapetum lucidum and the presence of a retinal fovea. The unusual behavioral response of spectral tarsiers to moonlight, relative to most other mammals, suggests that lunar attraction may be an adaptive behavioral response exhibited by secondarily nocturnal primates who still rely on light to aid their locating resources.

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Early hominid brain evolution: New reconstructions of endocasts. J. GUYER, Department of Anthropology, SUNY at Albany, NY 12222.

New technologies and methods have been applied to analyzing endocasts reproduced from the original specimens of OH 5 (Zinj, A. or P. boisei) and Sts 71 (A. africanus). New reconstructions of endocasts were produced that reflect newly discovered details of cortical morphology, and that provide new and more accurate cranial capacity estimates. Specifically, an endocast prepared from the original reconstruction of OH 5, an articulated copy of the skull, and the Wenner Gren casts of the five major cranial fragments comprising the skull were used to produce a new reconstruction of the endocast. The reconstructed endocast, reported on here, reflects species-specific cortical morphology revealed on specimens that were discovered after production of the original reconstruction of the endocast.

Specifically, the five fragments were coated with pigmented silicone latex so that reflections of the interior cranial surfaces would stand out in sharp contrast against the reconstructed surfaces of the endocast. After further refinement of the endocast in light of newly discovered fossils, the final reconstruction was compared with measurements and drawings from the Zinj monograph (Tobias, 1967) revealing a variation of less than 1% and a total endocranial capacity smaller than the original estimate.

The same general procedures were used to reconstruct the endocast of Sts 71 using a comparative collection of endocasts from gracile australopithecines, revealing an endocranial capacity larger than that estimated for the unreconstructed specimen. These new techniques, and the provocative results obtained, provide an impetus for further scrutiny regarding early hominid brain evolution.

Supported by NSF grant SBR-9729796.

Russian Far East Neolithic burials: comparative dental anthropological analysis of Boisman 2. A.M. HAEUSSLER, Arizona State University, Tempe, AZ 85287-2402.

The most ancient human remains found in the Russian Far East are those from the Neolithic coastal site of Boisman 2, south of Vladivostok, Primor'e. Comparative

analysis of dental morphological trait frequencies shows that the Boisman 2 sample is dentally more similar to Neolithic samples from Central and Western Siberian Russia than to Neolithic samples from Ukraine and European Russia. However, archaeological remains from Boisman 2 burials fail to display a close cultural relationship with those found in Central and Western Siberia.

Odontological trait analysis further indicates that the Neolithic Boisman 2 sample is more like the prehistoric Bering Sea coastal sample from Ekven cemetery on the Chukchi Peninsula and contemporary Eskimos and Chukchi than to contemporary non-coastal peoples of the Russian Far East.

These results indicate an ancient biological, as well as cultural, connection between the inhabitants of Boisman 2 and prehistoric individuals buried at Ekven and contemporary Eskimos and Chukchi of the Chukchi Peninsula.

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Blood pressure variation in urban Caribbean-Americans. R.A. HALBERSTEIN, University of Miami, Coral Gables, FL 33124-2005.

Hypertension prevalence, awareness of the disorder, and outcomes of traditional ethnomedical and modern biomedical treatments were investigated in a probability sample of 255 Caribbean-born permanent residents of Miami, FL. The participants were age 21 and older, represented 16 different Caribbean countries of origin, and had lived in Miami for an average of 15 years. Each subject was tested with a digital BP/pulse monitor at a University of Miami family health clinic and a university-sponsored health fair. Extensive demographic and medical history information was collected with a standardized questionnaire.

Over 25% of the sample exhibited BPs above 140/90, and a positive correlation was found between age and BP level. Gender differences were not statistically significant. Although a rise in BP might be predicted for individuals experiencing the stress of migration and permanent resettlement in a large city in a new country, mean systolic and diastolic values in the sample reported here are actually well below the majority of indigenous Caribbean populations. Since this Caribbean-born group still technically represents the gene pools of the countries of origin, this discrepancy is most likely explainable in terms of environmental change.These individuals have undergone a major cultural transition to drinking water supplies containing sharply reduced salt content, more diversified diets with relatively less seafood intake, different occupations with accompanying modifications in work schedules and physical activities, and the greater availability of commercial over-the-counter and prescription medications. Caribbean-American immigrants in Miami freely patronize available ethnomedical practitioners and continue to utilize traditional herbal remedies (63.5% of the present sample) along with modern biomedical health care facilities and synthetic anti-hypertensive drugs, thus allowing expanded treatment options.

Metric analysis of non-metric traits categorizing nasal form. R.L.HALL, Anthropology, Oregon State University, Corvallis, OR 97331.

Nasal features such as size, shape, and projection of the nasal bridge constitute major components of variation in the modern human skull that have been related functionally to climatic variables. These features also have been used to characterize populations and to make forensic identifications of individuals. As part of a study of geographic variation in nasal form, using metric variables taken largely from Howells (1973) and non-metric variables adapted from Lahr (1995), this paper examines the metric aspects of three key qualitative traits of the nose: nasal saddle form, which uses four categories to describe the angle between the two nasal bones at the nasal bridge; infraglabellar notch profile, which categorizes the angle glabella makes with the nasal bones in four grades; and the form of the inferior nasal margin, which in this sample consists of nasal margins with a single border, single-border margins with a sill behind, and margins that are rounded. Metric traits are interorbital breadth and minimal breadth of the nasals (a chord), and the subtenses to both of them, and nasal height, breadth, and index. Study specimens are 335 adult-aged skulls from populations indigenous to Western North and South America, India, Europe, and Mongolia, which were measured at The Royal British Columbia Museum, the Laboratory of Archaeology at Simon Fraser University, the University of Oregon Museum of Natural History, and the San Diego Museum of Man.

Findings. Nasal saddle form and the infraglabellar notch were highly associated ($\chi^2=89.3$, $p<.000$). Neither saddle nor notch form is associated with margin type ($\chi^2=8.7$, $p<.189$ and $\chi^2=1.212$, $p<.876$, respectively), but the principal metric traits that distinguished saddle and notch forms also distinguished forms of the inferior margin. Analysis of variance found highly significant differences in subtenses to interorbital breadth and to the minimal breadth of the nasals for all three non-metric traits. Subtenses were low in noses categorized as flat by saddle and notch form, and were high in noses having a single margin at the lower nasal border. In addition to offering other findings, this paper considers how relationships between non-metric and metric measures of nasal form can be used in forensic work as well as in interpretating complexities of intra-populational variation in modern *Homo sapiens*.

Paleoclimate at Amud Cave, Israel: stable isotope analysis of tooth enamel carbonate. K.A. HALLIN[1], H.P. SCHWARCZ [2], E. HOVERS[3], R. RABINOVICH[4], and M.J. SCHOENINGER[1]. [1]University of Wisconsin, Madison WI 53706, [2]McMaster University, Hamilton ON, L8S 4M1, [3]Harvard University, Cambridge, MA, and [4]Hebrew University, Jerusalem

The appearance of Neandertals in the Southern Levant approximately 70-40 Ky. may be attributed to European

climate degeneration at the onset of the last glaciation (OIS 4). Climate data from the Levant are sparse although speleothem stable isotope data from Jerusalem, Israel (Bar-Matthews et al., in press; Frumkin et al., submitted) track northwestern European and north African glacial/interglacial events over the last 160 Ky. We present a stable isotope profile of Amud Cave, located in the Upper Galilee of Israel, using tooth enamel carbonate of modern and fossil Capra and Gazella as proxy climate indicators. $\delta^{18}O$ values of Capra, an obligate-drinking, grazing species, reflect rainfall $\delta^{18}O$ which, in turn, is temperature dependent. $\delta^{13}C$ values of gazelle, a browser/grazer, reflect the availability and isotopic composition of C_3 vegetation which varies with rainfall amount. The fossil sample consisted of Gazella gazella and Capra aegagrus teeth from Mousterian deposits ranging in age from 70-50 ky (Valladas et al., in press). As predicted, there were differences in the isotopic signals recorded by the two animal species. Gazelle $\delta^{18}O$ values remain relatively constant, reflecting their dependence on plant water for body water; Capra values decrease by 2‰ from B1/6 to B4 indicating a decrease in ambient temperature. In contrast, Capra $\delta^{13}C$ values remain constant while gazelle $\delta^{13}C$ values decrease by 3‰ from B1/6 to B4, suggesting an increase in canopy cover. Comparison with the speleothem data suggests that during the earlier occupation, hominids at Amud lived in cooler conditions with more woodland near the cave than existed during the later occupation period.

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New World Y chromosome founder haplotypes and the peopling of the Americas. M. F. HAMMER, S. L. ZEGURA, University of Arizona, Tucson, AZ 85721, A. BERGEN, J. C. LONG, NIAAA, NIH, Bethesda, MD 20852, W. KLITZ, University of California, Berkeley, CA 94720, R. C. GRIFFITHS, Monash University, Clayton 3168, Australia, A. R. TEMPLETON, Washington University, St. Louis, MO 63130, L. P. OSIPOVA, O. L. POSUKH, Institute of Cytology and Genetics, Novosibirsk, Russia, and T. M. KARAFET, University of Arizona, Tucson, AZ 85721, and Institute of Cytology and Genetics, Russia.

Haplotypes constructed from Y chromosome markers are used to trace the origins of Native Americans. A set of 12 biallelic polymorphisms and two Y-linked microsatellites were genotyped in a sample of 2198 males from 60 global populations, including 19 Native American and 15 indigenous North Asian groups.

In contrast to previous findings based on Y chromosome data, our new results suggest more than one Native American paternal founder haplotype. We postulate that of the nine unique haplotypes found in Native Americans, haplotypes 1C and 1F are the best candidates for major New World founder haplotypes, while haplotypes 1B, 1I, and 1U may either be minor founder haplotypes and/or they arrived in the New World via recent admixture. Two of the other four haplotypes (YAP+ haplotypes 4 and 5) are most probably present because of post-Columbian admixture, while 1G may have originated in the New World, and the Old World source of the final New World haplotype (1D) remains an open question.

The contrasting distribution patterns of the two major candidate founder haplotypes in Asia and the New World, as well as the results of a nested cladistic analysis, suggest more than one paternal migration to the Americas. These patterns are best explained by a model in which founder populations carrying haplotype 1C from the ancient homeland of the Kets and Selkups (southwestern Siberia), and haplotype 1F from the region around Lake Baikal, migrated separately through northeastern Siberia *en route* to the New World.

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The derived nature of primate cheiridial morphology and the evolution of postural diversity in archontan mammals. M.W. HAMRICK and R. O'NEAL, Department of Anthropology, Kent State University, OH 44242.

Comparative functional analysis of tarsal morphology has suggested to previous authors that the various clades of archontan mammals diversified in their tarsal joint structure and function in relation to different foot postures. For example, euprimates were shown to possess derived morphologies related to pedal inversion and hallucial grasping whereas dermopterans and bats possessed features related to highly inverted foot postures during hindlimb suspension. Tree shrews were found to exhibit morphologies related to lower ranges of foot inversion associated with positional behaviors on large-diameter substrates.

We investigated patterns of diversification in foot morphology and function among archontans by testing for differences in phalangeal proportions in a large sample of extant euprimates, dermopterans, scandentians, and mega- and micro-chiropterans. Phalangeal proportions were also studied in a comparative sample of arboreal rodents and marsupials. Data for several fossil euprimates and bats from the Eocene of North America and Europe were included in the analysis as well. Relative lengths of the proximal, intermediate, and distal phalanges were expressed as percentages of total toe length. Morphological patterns were displayed using ternary diagrams.

Results show that both the extant and extinct euprimates possess relatively elongate proximal phalanges and short distal phalanges related to grasping small-diameter supports using clawless digits. Dermopterans and chiropterans share relatively elongate intermediate phalanges related to the use of their toes as modified hooks during below-branch suspensory postures. Finally, scandentians resemble other small-bodied taxa that prefer postural behaviors on large-diameter substrates (e.g., *Sciurus*) in having intermediate and distal phalanges that are similar to one another in their relative lengths. Our results indicate that the evolutionary diversification of archontan postural behavior and substrate use involved significant changes in cheiridial morphology and function.

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Genes and their interactions with environmental risk factors of type 2 diabetes: Experiences from studies of Mexican Americans. C.L. HANIS, Human Genetics Center, University of Texas Health Science Center, Houston, TX 77030.

The genetics of the common chronic diseases are characterized by numerous interacting genetic and environmental factors that are likely heterogeneous within and among populations, hence identification of specific factors from among the milieu has proven difficult. Understanding the underlying mechanisms and interactions that lead to disease will only come with the identification of specific factors (whether genetic or environmental) and subsequent statistical and biological manipulations. We report here progress towards identifying specific alleles that increase risk for type 2 diabetes and the exploitation of such information in elucidating genetic and environmental interactions.

For the past 18 years we have amassed a body of genetic and epidemiologic data on the distribution of and risk factors for type 2 diabetes among Mexican Americans in Starr County, Texas. Data include a complete genome search involving 509 markers that has localized one locus (denoted NIDDM1) near D2S140. Subsequent mapping has narrowed the region to less than 100 kb and refinement continues. Already at this level, this finding permits examining interactions with other loci and environmental factors. For example, conditioning the genome scan on genotype at NIDDM1 identifies a second locus on chromosome 15 near CYP19 that achieves genome-wide significance. Based on these and other analyses, we have begun to formulate a model in which common variation at NIDDM1 interacts with variation on chromosome 15 to account for as much as 50% of the aggregation of type 2 diabetes in Mexican American families. As these loci are identified, we will examine their interactions with environmental factors including diet, exercise, and SES. It is likely that such factors result in differential consequences of having risk raising alleles. It is also likely that these factors alter the interactions among loci. Together, these interactions determine the development of diabetes and its complications.

An investigation into the degree of hallux abduction of the OH8 foot. W.E.H.HARCOURT-SMITH and L.C.AIELLO, Department of Anthropology, University College London, England WC1E 6BT.

The degree of hallux abduction in the Olduvai foot (OH8) has been at the focus of debate for over 30 years. In the original description of the foot (Day & Napier 1964) the hallux was described as being fully adducted and in line with the other metatarsals, as well as being unopposable. Since then others have suggested that the foot may have been characterized by a degree of opposability intermediate between that of modern humans and extant great apes (e.g. Oxnard & Lisowski 1980; Lewis 1980). This debate has current significance in the context of the OH62 skeleton, and the inference based on this skeleton that *Homo habilis* may have lead an at least partially arboreal lifestyle and may have been phylogenetically related to a more arboreal *Australopithecus africanus* (McHenry & Berger 1998). In this contribution hallux opposability of the OH8 foot is tested through a metrical analysis of the medial cuneiform and surrounding tarsal bones. A series of 12 functionally relevant linear and angular measurements were devised to reflect medial cuneiform size, morphology and opposability of the hallux. A further 7 measurements were also taken on the surrounding tarsals and metatarsals (navicular, talus, intermediate cuneiform, 1st & 2nd metatarsals) to reflect their sizes, morphologies and functional inter-relationships.
The comparative sample is comprised of the foot bones of 40 adult gorillas, 40 adult chimpanzees, 64 shod adult humans, and 31 unshod adult humans. Bivariate and multivariate analysis indicate that the morphology of the OH8 medial cuneiform falls within the range of variation found in modern human shod and unshod adults and well outside the range of variation of the ape comparative sample. The implication of this is that the OH8 foot did not have any unusual degree of opposability in relation to the human comparative sample and, at least in this feature, is compatible with a more terrestrial lifestyle than has been suggested for some of the earlier australopithecines. Furthermore, the morphology of some of the other tarsal bones shows certain unique features, such as a very wedge-shaped intermediate cuneiform, which probably reflects the fact that OH8 had a unique gait pattern in relation to both modern humans and extant apes.

The tempo of dental maturation: Caucasoid population differences. E. F. HARRIS, Orthodontics, University of Tennessee, Memphis 38163

Populations differ in their adult sizes and, as well, in the tempo of growth that individuals experience to reach adulthood. The tempo of growth has both an environmental and a genetic component, and recent work suggests the latter is fairly strong. The assessment of dental age consists of comparing individuals to a reference sample. This involves the critical presumption that the tempo of growth of the reference sample is representative of the sex, ethnic, and regional background of the cases being evaluated.

Controlling for race and sex is not sufficient because of regional population differences among contemporary whites. There are at least six studies of caucasoids where ages at the formative stages of all permanent tooth types have been published. In the present study, dental ages are contrasted among these reports. A method is described to produce dental ages from other reports using the popular Demirjian, Goldstein and Tanner method (*Hum Biol* 1973), along with statistical confidence limits. A female precedence is evident in all studies. However, tempos differ dramatically among caucasoid samples, disproportionately so during adolescence. For all known comparative studies, use of the Demirjian system—based on French-Canadian children from Montreal—appreciably over-estimates the degree of maturity of adolescents in other caucasoid populations. A few samples show a uniform offset from the Demirjian

standards across all ages, but most show a marked increase in over-estimation from about 9 years of age onward. The departures are overt, with 2 to 3 years between group means. It seems that the French-Canadian children spend a lengthy amount of time in adolescence, at least as judged from their rates of tooth formation.

Contrasts in this study provide a strong cautionary note that researchers need independent evidence that the reference data are indeed repre-sentative before claims are make of individuals' tempos of growth.

Scaling of lumbar vertebrae in anthropoid primates: its implications for the positional behavior and phylogenetic affinities of *Proconsul*. T. HARRISON, Dept. Anthropology, New York University, NY 10003 and W.J. SANDERS, Museum of Paleontology, University of Michigan, MI 48109.

Relative size of lumbar centrum surface area in *Proconsul heseloni* (KNM-RU 2036) and *P. nyanzae* (KNM-MW 13142) was investigated in the context of a comparative allometric study of lumbar vertebrae from a large sample of extant anthropoids. Centrum surface area was measured from scaled photographs using an OPTIMAS video digitizing system. Lumbar vertebrae were selected for analysis because of the close association between positional behavior and morphology in this region of the axial skeleton, and the strong correlation between lumbar vertebral proportions and body mass among extant non-human catarrhines.

Results of this analysis confirm earlier work by Sanders and Bodenbender (1994) that the lumbar centra of *Proconsul* are considerably smaller than expected for modern catarrhines of similar size. For instance, regressions of limb bone dimensions reasonably predict average body masses of 9.8 kg and 37.4 kg for RU 2036 and MW 13142 respectively, while centrum surface area regressions predict body masses of only 6.4-7.7 kg and 19.4 kg respectively. To gain a clearer appreciation of the underlying reasons for this discordance in scaling, comparisons were extended to include non-catarrhine primates. These data show that *Proconsul* is more closely comparable to extant platyrrhines, which tend to have smaller centra relative to their body weight than extant catarrhines.

Differences in the relative proportions of the lumbar centra between platyrrhines and catarrhines presumably relate to major differences in positional behavior between these two clades. The relatively larger lumbar centra in catarrhines are functionally associated with a greater emphasis on the adoption of more orthograde postures. The occurrence of ischial callosities, unique to catarrhines, are also likely to be part of this same complex, since in combination they enable cercopithecids and hylobatids to sit or sleep upright on relatively small diameter perches. As was initially proposed by Washburn (1958), this adaptation could offer an important selective advantage to catarrhines as a means of protection from arboreal predators, and is possibly linked to the co-evolution of felids. This complex of anatomical specializations, associated with the emergence of an important behavioral innovation, represents a key synapomorphy linking all extant catarrhines. The primitive retention of relatively small lumbar centra and the absence of expanded ischial tuberosities demonstrate that *Proconsul* lacked a major defining characteristic of modern catarrhines. The most reasonable interpretation is that *Proconsul* represents a stem catarrhine that diverged prior to the last common ancestor of all extant members of the clade.

Skeletal maturity of human foot bones and radiographic estimation of sex and age in adolescents and juveniles. W.C. HARTWIG, R.A. ROWAN, Touro University College of Osteopathic Medicine, San Francisco, CA 94115; J.M WHITAKER, T. WILLIAMS and L. ROUSSEAU, California College of Podiatric Medicine, San Francisco, CA 94115.

Bones of the foot reveal few clues for forensic determination when studied individually, but may provide useful age and sex discriminating power when studied in combination. Absolute differences between males and females or between different degrees of skeletal maturity are useful thresholds even if they only apply to narrow chronological age ranges in children and young adults.

In this study we examined foot radiographs of more than 100 individuals and scored each foot bone for its degree of skeletal maturity as determined on a four point scale. In addition, each bone with a secondary center of ossification was scored for degree of maturity of the epiphysis (four point scale) and for degree of fusion (five point scale). As with other osteological scoring systems, inter-observer error is a major concern. We present a scoring system that draws upon radiographic standards and the least ambiguous character state thresholds in order to minimize inter-observer unreliability.

Scores for each foot bone were compared across individuals, but the most powerful discriminations were achieved when the permutations for each bone in the foot (primary center - secondary center - state of fusion) were combined to create secondary or tertiary ordinal scores of skeletal maturity. This analysis identified absolute differences of at least 48 months between males and females in the age of onset of skeletal maturity in most individual foot bones. The age ranges of 11-14 years in boys and 8-12 years in girls were the ranges for which we obtained the most powerful discriminators.

In addition to meeting the forensic objectives of this study, we collected data to supplement current knowledge of ossification patterns in the human foot. Our data indicate that the foot skeleton of normal females can complete growth much earlier than reference tables suggest, and that the first metatarsal frequently has a distal epiphysis as well as a proximal one.

The Indodont dental pattern of prehistoric South Asia and early world affinities. D.E. HAWKEY, Department of Anthropology, SUNY-Binghamton, NY 13902-6000.

Comparative dental morphology data for 10 Early (n=1,622 individuals) and 16 Later (n_i=2,576) populations of India, Pakistan, and Sri Lanka, suggest that all South Asian groups share a similar dental pattern, both through time and across geographic distance. When compared to the Early World average for 29 dental traits, the pattern ("Indodont") is characterized by relatively few high frequency traits (hypocone presence M^2, 1-root P^1, Y-groove M_2, 4-cusped M_2). Low-to-absent frequency traits include winging I^1, tuberculum dentale I^2, canine

mesial ridge^{C}, distal accessory ridge^{C} and $_{C}$. Carabelli's trait M^{1}, 3-root M^{2} and M_{1}, disto-sagittal ridge P^{1}, enamel extension M^{1}, and odontome $P^{1,2}$ and $P_{1,2}$. All other traits were similar to the Early World average, including shovel I^{1}, double shovel I^{1}, cusp 5 M^{1}, parastyle M^{3}, 6-cusped M_{1}, deflecting wrinkle M_{1}, protostylid M_{1}, and cusp 7 M_{1}.

Results from Early South Asia were then compared to dental data obtained from published sources for 14 Early World (n_{i}=2,586) and 24 Later World (n_{i}=16,091) populations. Mean Measure of Divergence (MMD) values along with other multivariate analyses of the dental traits lend support to prior research by Turner (1992), and Hawkey and Kennedy (1993), proposing an early dental pattern shared by South and Southeast Asians. Additional affinities between Early South Asian and Early Eurasian (Ukrainian Black Sea) groups suggest two possibilities. 1) This early dental pattern ("Indo-Sundadont") was once widely distributed geographically. 2) Indo-Sundadonty later diverged into two subsequent dental patterns, with the Indodonts more similar to Early Near-Mid Eastern/Eurasian/North European peoples, and the Southeast Asian Sundadonts more like Early North Asians (Sinodonts). Affinities of the earliest Sri Lankan group (dating to Late Pleistocene-Early Holocene) with modern Melanesians and Australian Aborigines also suggest possible colonization of the Sahul region by peoples of South/Southeast Asia.

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Female-female inspections in muriquis (Brachyteles arachnoides). D.N. HAWKINS and K.B. STRIER, Anthropology, University of Wisconsin-Madison, 53706.

Many female primates are known to use pheromonal and behavioral cues to communicate information about their reproductive conditions to males during heterosexual inspections. Less is known about why females might participate in isosexual inspections To investigate this question, we examine whether isosexual inspections differ from heterosexual inspections in terms of their timing relative to breeding seasonality and the participation of females with different life histories in wild muriqui monkeys (Brachyteles arachnoides).

Data were collected from July 1992 to June 1998 at the Estacão Biológica de Caratinga in Minas Gerais, Brazil. Males accounted for 97.6% of the 2,767 inspections and all of the 652 copulations involving 21 sexually mature females and 27 males that were observed. The 68 isosexual inspections were performed by 19 different females.

Two-thirds of the copulations occurred during the annual rainy season months, from October to March, but there were significant differences in the timing of heterosexual and isosexual inspections by season (X^{2} =11.56, df=1, p<0.01). Although over 70% of the heterosexual inspections occurred during the rainy season, isosexual inspections were evenly divided between the rainy (n=35) and dry (n=33) seasons.

When analyzed by month, the frequencies of copulations correlated with those of heterosexual inspections (r_{s}=0.08, n=72, p<0.01), but not isosexual inspections (r_{s}=0.12, n= 72, p>0.05). There was no association between heterosexual and isosexual inspection frequencies (r_{s}=0.07, n=72, p>0.05). Copulations were also more likely to occur within 0 ± 3 days of heterosexual inspections than isosexual inspections (X^{2} =165.89, df=1, p<0.001).

Heterosexual and isosexual inspection frequencies were positively related among females (r_{s}=0.56, n=19, p<0.05). No significant differences were detected in the ratio of isosexual-to-heterosexual inspections among older, long-term resident females, middle-aged females, or young females (Kruskal-Wallis=0.11, df=2, p>0.05).

These results suggest that isosexual inspections are less related to sexual and reproductive activity than heterosexual inspections and may therefore serve other functions. Further investigations into social relations and pheromonal communication among female muriquis will provide additional insights into the functions of isosexual inspections.

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Population bottlenecks and human evolution. JOHN HAWKS, Paleoanthropology Laboratory, Department of Anthropology, University of Michigan, Ann Arbor MI 48109-1382.

This paper reviews genetic and non-genetic sources of information regarding the population size of the human lineage in the past, and how it has changed over time. The possibility of population size bottlenecks at different times in human history is examined, and an overview is provided of the application of different sources of evidence for understanding this demographic component of human evolution. Computer simulations of human demographic history, using modifications of the coalescent algorithm to account for population size change, migration, and other demographic factors, are used to test hypotheses concerning population size in ancestral human populations. In particular, the hypothesis of a past human population size bottleneck is comprehensively tested for several parameters of bottleneck time, severity, and duration. The hypothesis of a recent severe population bottleneck in the human lineage can account for limited mtDNA variation and the evidence in mtDNA and microsatellite data of a recent population expansion. But such a recent population bottleneck is rejected by the pattern of diversity in autosomal DNA, which shows no sign of a severe recent population contraction. A long-lasting, shallow population size bottleneck or series of bottlenecks, which have been suggested to account for small long-term average effective population size in nuclear and mitochondrial genes, is inconsistent with paleontological, archaeological, and genetic evidence of long-term human occupation of different areas of the Old World and common patterns of evolution across this range, unless we admit that effective size is complexly related and many times smaller than the size of the human species. Comparison with other mammalian species suggests that this may in fact be the case. It is concluded that, despite the application of computationally intensive methods to analyze the pattern of human genetic variation, significant paleodemographic insights from this line of inquiry will be difficult to obtain.

Mitochondrial DNA variation of prehistoric Eastern Canadian Arctic inhabitants. M.G. HAYES, Laboratory of Biological Anthropology, University of Utah, Salt Lake City, UT 84112

The Eastern Canadian Arctic has been inhabited by humans for less than 5000 years, and is characterized by a phenomenal transition in the archaeological record ca. 1000 years ago from Paleo-Eskimo cultures to Neo-Eskimo cultures. This transition is argued to represent not only a culture replacement event, but also a population replacement event (Park 1993).

Ancient DNA was extracted from rib samples of Paleo-Eskimo (Dorset) and Neo-Eskimo (Thule) culture-associated skeletons, archaeologically recovered from the Hudson Bay vicinity. Regions of the mitochondrial DNA (mtDNA) genome containing a 9bp deletion and restriction site polymorphisms characterizing ubiquitous Native American maternal lineages were amplified using PCR, and scored for the presence or absence of these markers.

Preliminary results indicate the prehistoric inhabitants associated with these Eastern Arctic cultures possess little genetic variation, similar to the pattern observed among living inhabitants of the North American Arctic (Merriwether et al 1995).

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Permanent teeth emergence symmetry in functional lateralities. HEIKKINEN, T.*, ALVESALO, L.*, OSBORNE, R.H.**, TIENARI, J.***. *Dept. of Oral Development and Orthodontics, Institute of Dentistry ,***Dept. of Applied Mathematics / Statistics, University of Oulu, Finland. **Dept. of Anthropology, Univ. of Wisconsin, USA

Dental casts of 2092 young black and white Americans (mean age 8.5, range 6 to 12 years) with detailed postnatal neurological data on the laterality of handedness, eyedness and footedness from the Collaborative Perinatal Study were examined for the proportions of symmetric and left – right advanced eruption of the antimeres using 4-graded eruption scale.

The proportions varied significantly in footedness and eyedness but not in handedness; left-footedness was significantly associated with increased proportion of symmetric pairs of the maxillary first molar and mandibular lateral incisor, non-right-eyedness (= left or indetermined eyedness) with increased proportion of symmetric eruption and nonbalanced proportions of asymmetric eruption in maxillary central incisors. Children with any deviation from the true right-sidedness (all three functional lateralities combined) had significantly increased proportion of symmetric upper first molars.

Although tooth emergence timing is multifactorial including local controlling factors during phases of eruption the result may indicate that tooth eruption patterns are structural in nature and under the influence of early developmental factors as suggested by Main (1966), Glasstone (1967), Friedlander and Bailit (1969) and Garn et al. (1981). While the timing of tooth eruption processes primarily are programmed before crown mineralization, starting from late gestation in the case of first permanent teeth, it can be speculated that the development of the dentition may contain information about prenatal and early postnatal asymmetric growth and developmental processes associated with functional lateralities.

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Emergence of despotic and egalitarian societies: an individual-oriented model for hypothesis generation on macaques. C. K. HEMELRIJK, Department of Computer Science, University of Zurich, CH-8057.

Here, I present an individual-oriented model of the origination of differences between typically despotic and egalitarian macaque species. The model consists of a virtual world inhabited by simple entities, which only aggregate and, upon meeting one another, may perform dominance interactions in which the effects of winning and losing are self-reinforcing. The behavior of these entities is studied in a similar way to that of real animals. It will be shown that by merely increasing the value of one parameter (representing intensity of aggression), social behavioral patterns switch from those comparable to egalitarian to those similar to despotic macaque species (e.g. with larger rank and physical distance among entities, lower frequencies of interactions, less symmetrical and more rank-correlated attack). Additionally, fiercely aggressive entities show a clearer spatial centrality of dominants and more rank-overlap between the sexes. Because of its correspondence with patterns in real macaques, the

model contributes to the study of social behavior in three ways: 1) it automatically explains the interconnection between variables representing dominance style. 2) The model makes it worthwhile to compare despotic and egalitarian macaque species on certain new behavioral characteristics. 3) Because of the internal simplicity of its entities, the model provides parsimonious hypotheses for social/spatial behavior, which can be tested in real macaques.

Food for thought: evaluating phenological methods as food availability estimates. C.A. HEMINGWAY, Duke University, Durham, NC 27708, D.J. OVERDORFF, University of Texas, Austin, TX 78712

A central problem in primate ecology is to understand behavioral changes in response to changes in food availability. While the actual availability of food for a particular primate population may be unknowable, phenological patterns are used as the closest approximations. It is recognized that data collection method can affect the resulting values of food availability, however, the underlying influences are not well studied. Also lacking are comparisons of the efficacy of various phenological methods in sampling primate diets.

We investigate the effects of phenological sampling method, sample size and species composition on estimates of food availability. We compare values obtained from selected tree observations and systematic transect monitoring in Ranomafana National Park, Madagascar. Subsequently, we compare how well these two methods sample food items for three sympatric primates: *Propithecus diadema edwardsi, Eulemur fulvus rufus*, and *Eulemur rubriventer*.

By generating bootstrapped samples derived from the transect tree data set, we simulated selected tree data sets that differed in sample size and species composition. The observed values fell within the bootstrapped confidence intervals, indicating no significant effect of sampling protocol or sample size. However, high individual variation in reproductive activity within species was responsible for producing extremely wide confidence intervals. Observed samples composed of different plant species, whether based on species attributes such as life form or categories such as food versus non-food plants, consistently produced different phenological patterns. We discuss the general applicability of these results in light of similar bootstrapped sampling of phenological data collected in Brunei, Southeast Asia.

A wider diversity of items, including rare foods, and a higher percentage of main items eaten by the three Malagasy primates was sampled by the transect tree method than the selected tree method. Sampling method greatly impacts food availability estimates and may alter conclusions regarding primate responses to resource availability.

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A craniometric test of three models for the origins of Bronze Age North Bactrians. B.E. HEMPHILL, Department of Anthropology, Vanderbilt University, Nashville, TN 37235.

Discovery of a previously unknown Bronze Age civilization (Oxus Civilization) centered on the oases of Central Asia revealed the presence of large pre-planned urban centers immediately atop sterile soil. Given the absence of local antecedents, the sudden appearance and proliferation of Oxus Civilization urban centers immediately raised the issue of where the inhabitants of these these ancient cities came from. Three hypotheses have been offered to account for the origin of North Bactrian Oxus Civilization populations. These include the early influence model, the late colonization model, and the trichotomy model.

Eleven cranial measurements from 12 Aeneolithic and Bronze Age samples, encompassing 657 adults from Central Asia, Iran, and the Indus Valley were compared to test which, if any, of these hypotheses are supported by the pattern of phenetic affinities possessed by the Oxus Civilization inhabitants of the north Bactrian oasis. Craniometric differences between samples were compared with Mahalanobis generalized distance (d^2) and patterns of phenetic affinity were assessed with two types of cluster analysis, multidimensional scaling, and principal coordinates analysis.

Results of this analysis provide no support for the late colonization model or the trichotomy model, but do offer some support for the early influence model. Nevertheless, the early influence model fails to account for a possible shift in interregional contacts and perhaps gene flow, from western Chinese populations prior to 2000 B.C. to gene flow from populations of the Zeravshan Valley after 2000 B.C., that may have played a major role in the formation of Oxus Civilization populations within the north Bactrian oasis.

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Physical status of Aborigines in two South Australian reserves. M HENNEBERG and KM LAMBERT, Anatomical Sciences, University of Adelaide, Adelaide, 5005, Australia

Some Australian Aborigines still live in separate settlements that were founded before Aborigines were given full rights of citizens. In denser populated areas these settlements are scattered among towns founded by European settlers. Inhabitants of such settlements are provided by the government with housing, welfare and access to health service and education. A mixed-longitudinal study of physical status of the inhabitants of two

such reserves - Gerard and Raukkan - has commenced in 1996-97 at the invitation of local Aboriginal Councils. Both communities are located on the River Murray in South Australia. Each has about 150 inhabitants. Here we report results of the observations collected on the first occasion on 151 participants. These comprise 85 children (age 1-17 yrs) and 66 adults (age 18-76 years). Average z-scores of body height of both boys (-0.50, N=41) and girls (-0.43, N=44) are significantly below NCHS reference, but are higher than those of adult males (-0.74, N=31) and females (-1.06, N=35). Arm circumferences of children and adults do not differ significantly from the reference. Body weights of boys and girls, although their average z-scores are positive, do not differ significantly from NCHS reference. The same is true of adult male body weight (z=+0.21), but adult female average body weight very significantly exceeds that of the reference (z= +0.89). Body Weight Index averages of boys, girls and males lie just above the 50th percentile of the reference, while the female average is close to the 80th percentile. This pattern of short stature coupled with weight exceeding the reference is characteristic for people from developing, rather than developed nations.

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Stable isotope analysis of the diet of the inhabitants of the Ancient Greek colony of Metaponto in Italy, 7th-2nd c BCE. R.J. HENNEBERG[1], F.D. PATE[2], and M. HENNEBERG[1] Anatomical Sciences, University of Adelaide, Adelaide 5005, [2]Archeology, Flinders University, Adelaide 5001, South Australia

Skeletal remains of coastal urban and rural inland populations of the Ancient Greek colony of Metaponto in Southern Italy were sampled for stable carbon and nitrogen isotopes. From the rural Pantanello burial ground, located approximately 3.5 km inland from the coastal city, samples from 21 skeletons were analysed (10 males 11 females), while the cemetery adjacent to the city walls (Crucinia) provided samples of 4 males. Average $\delta^{13}C$ values for the rural and the urban sample (-19.5 ‰ and -19.0 ‰ respectively) indicated high proportion of C3 plant products in the diet. As expected, this could be cereals, most probably wheat. Average $\delta^{15}N$ values for the inland and coastal samples (10.5 ‰ and 11.2 ‰ respectively) indicated about 40-50% of sea food in the diet, while carbon isotope values indicated 35-40 % sea food intake. Proportion of sea food was higher in the coastal population, although the difference in amounts of sea food consumed seems to be only about 10%. This could be expected among members of the same city-state residing at various distances from the shore. The exchange of foods, and internal migration, within the colony were probably high producing similar access to basic foodstuffs for all inhabitants.

Caries frequency of 57% (N=158, rural) to 73% (N=159,urban) supported the observation of high proportion of starchy foods in the diet.

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Malnutrition among northern peoples of Canada in the 1940s: an ecological disaster, not enzyme deficiencies. D.A. HERRING, S.ABONYI, Department of Anthropology, McMaster University, Hamilton, Canada L8S 4L9 and R. HOPPA, Max Planck Institute for Demographic Research, Laboratory of Survival and Longevity, D-18057 Rostock, Germany.

Analysis of Anglican Church burial registers for Moose Factory Cree First Nation over a 100-year period (1951-1950) reveals an extraordinary increase in infant death during the 1940s. Two years, 1941 and 1942, largely account for the observation, boosting the mean number of infant deaths for the period 1914-45 from 3.7 per annum to 13.5 deaths per annum and raising the proportional hazards rate for infants from .2885 (s.e.=.0303)to .3110 s.e.=.0285).

Correspondence and reports from the National Archives of Canada records for the Department Of Health and Welfare Nutrition Division, 1921-1971 indicates that high infant and child mortality were not limited to this community, but were widely reported by medical personnel and government officials throughout much of the Canadian north. Although there was agreement that poor nutrition was the fundamental cause for high rates of child mortality at this time, government-sponsored programs designed to alleviate the situation emphasized the introduction of fortified flours and maternal education. Case control experiments were set up in First Nations communities and residential schools and, later, research on enzyme deficiencies was sponsored. This scientific research agenda failed to address the basic problem: poverty and the depletion of animal resources that was the legacy of several hundred years of the fur trade.

Biological distance measures between Middle Missouri skeletal samples: a metric and nonmetric comparison. N.P. HERRMANN and R.L. JANTZ, Department of Anthropology, University of Tennessee, Knoxville, TN 37996

Distance measures derived from metric or nonmetric variables provide a general estimate of the biological relationship between populations being compared. However, are the distance patterns calculated from these two data set congruent? This question has been posed and investigated by numerous researchers with varying results.

In this paper, we examine the metric and nonmetric data from a series of Middle Missouri La Beau, Bad River, and La Roche Phase samples to address the

question presented above. Extensive research utilizing metric data has been conducted on these materials to address temporal trends and biological relationships. However, biological distance studies using the nonmetric data are very limited.

For this study, Mahalanobis's generalized distance matrices were derived from the nonmetric and metric data sets. Distance measures from the metric information were calculated using *RMET for Windows 2.0.* The discrete traits were analyzed using a polygenic threshold trait model developed by Williams-Blangero and Blangero (1989 Hum. Biol. *61*:1-12). The resulting distance matrices were then compared and assessed in relation to known temporal and geographic parameters.

Results from the analysis suggest that the correlation of the metric and nonmetric data is moderately low and insignificant based on the Mantel test. Furthermore, temporal and geographic correlations for both data sets are tenuous.

Children of the poor: Life in the Erie County Almshouse during the mid-nineteenth century. R. L. HIGGINS, SUNY College at Potsdam, NY 13676.

Inmate records (1830-1858) and the Record of Children (1863-1868) were analyzed to determine patterns of occupation among infants and children at the Erie County Almshouse. This study focused on the age distribution, nativity patterns and infant mortality through time.

Data were collected from the primary sources and checked twice for accuracy. Records that were complete with regard to age, sex, nativity and entry and exit dates were included in this study. The total database included 3,082 records spanning 38 years. Infant mortality was calculated as a monthly rate using the total length of stay as the denominator.

During the first two decades infants represented less than ten per cent of the population of children. A significant increase in this group occurred during the 1850's. The majority of the infants present during this period were born in the almshouse. The highest percentage of children occurred between the ages of 1 and 9 for all decades.

During the 1830's approximately 41% of the subadult inmates were foreign born. A significant increase in foreign-born children was observed during the 1850's. However, during the 1860's the number of foreign-born children decreased significantly, accounting for 22% of the population.

Infant mortality for foreign-born inmates fluctuated through time, and for all decades except 1840, was higher than that of native born infants.

These data suggest that the occupation of children at the Erie County Almshouse remained fairly consistent through time. The increase in infants during the last two decades, particularly during the 1850's, indicates that the almshouse was also serving as a maternity hospital. The significant increase in foreign-born children during the 1850's likely reflects the large-scale immigration that was occurring in the country as a whole at this time. Higher mortality among foreign-born infants suggests that poverty, complicated by immigration and subsequent institutionalization, was particularly devastating for this group.

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How we can eat and speak: hyoid movements in speech and feeding are different. KM HIIEMAE, SW MEDICIS, JB PALMER[1], BS JACKSON and J HEGENER. Bioengineering and Neuroscience, Syracuse University, NY 13244 and [1]Physical Medicine and Rehabilitation, The Johns Hopkins University, MD 31210.

This study tests the hypothesis that the hyoid bone moves continually in speech, but its movements occur within a 2D spatial domain (vertical and antero-posterior) different from that used in feeding.The dimensions of the oropharynx continually change, often almost obliterating the airway in feeding (Hiiemae and Palmer, *in press*). If, as postulated (Lieberman et al., 1992), speech requires vibrating columns of air of roughly equivalent dimensions be present in both the oral cavity and oropharynx, then the patterns of hyoid movement in feeding would not meet that criterion.

Lateral projection videofluorographic recordings (60 videofields/s) were made of 8 normal subjects (4 male, of whom 2 were not native English speakers, 4 female) eating soft and hard foods, then reading the 'Grandfather Passage' (which includes essentially all of the vowel consonant combinations used in English). Videotapes were digitized and Cartesian coordinates for upper canine and last molar, lower canine and last molar and hyoid obtained and manipulated (Microsoft Excel) to create movement time plots for hyoid and jaw movement in the X (antero-posterior) and Y (vertical) axes. The hyoid moves continually in speech, although the amplitude of jaw movement is less than found in feeding. The XY plot for the hyoid defines the 2D space through which it moves relative to the upper or lower occlusal planes. Since the hyoid domain drifts upwards and forwards during feeding but that drift is little affected by food type (Hegener et al., 1998), data for all foods was pooled and the domains for feeding and speech compared (giving $\pm$ 2500 data points for feeding and $\pm$ 3000 for speaking, each subject). In all cases, the hyoid domain for speech was anterior to that used in feeding, although often with minor overlap. Using the statistical test for the difference between means of two bivariate populations (Hald, 1965), the spatial domains for the two behaviors were found to be significantly different ($p < 0.0001$) in all cases.

We conclude a) the human hyoid moves continually in speech; and b) the anterior position of its movement domain creates an antero-posteriorly enlarged oropharynx and so a larger column of vibrating air. We conclude that the development of these two domains for hyoid movement explains the ability of *H. Sapiens* to both feed, protecting the larynx, and to speak by expanding the pharyngeal airway.

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